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Asuri et al.

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(54) **LASER DRIVER CIRCUIT AND SYSTEM**

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This patent is subject to a terminal disclaimer.

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(22) Filed: **Aug. 9, 2005**

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(51) **Int. Cl.**
H01S 3/00 (2006.01)

(52) **U.S. Cl.** **372/38.02**; 372/38.1; 372/38.07

(58) **Field of Classification Search** 372/38.1, 372/38.02, 38.07

See application file for complete search history.

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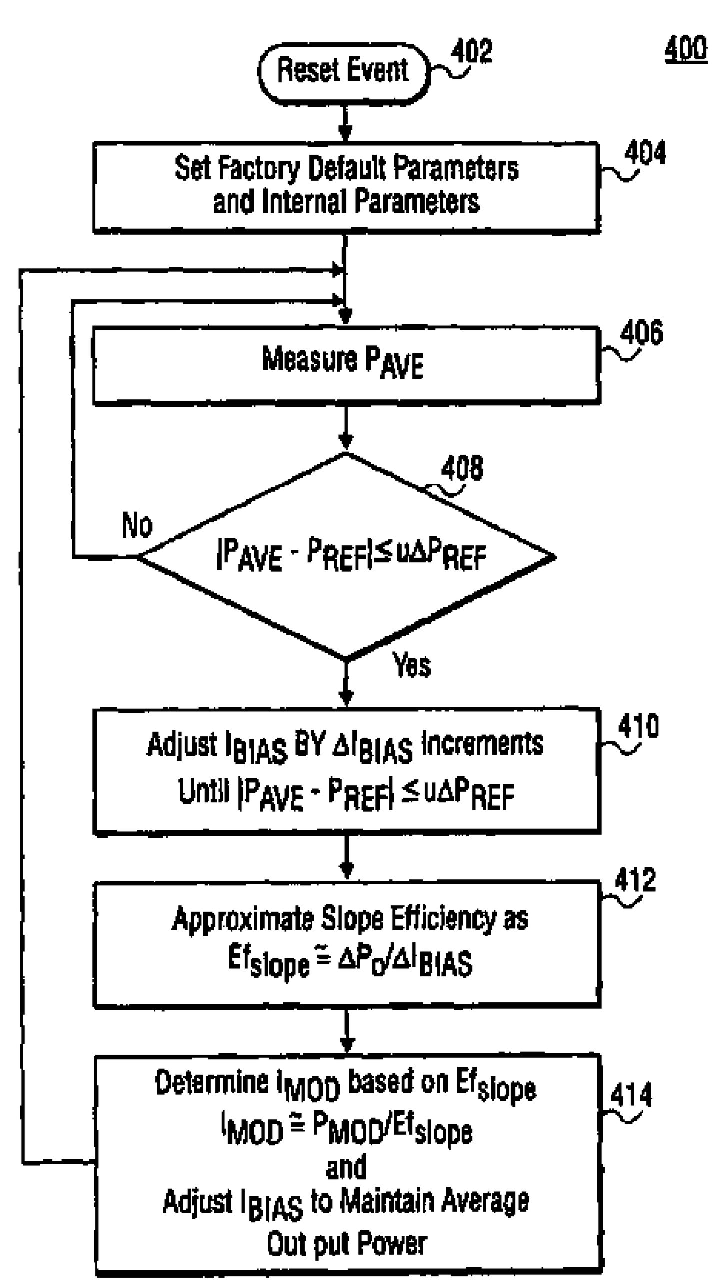
(57) **ABSTRACT**

A method, system, and electrical circuit for determining a magnitude of a modulation current provided to a laser device based upon an approximated slope efficiency, wherein the approximated slope efficiency is based upon at least one discrete incremental change in a bias current to the laser device and at least one change in output power from the laser device.

14 Claims, 7 Drawing Sheets



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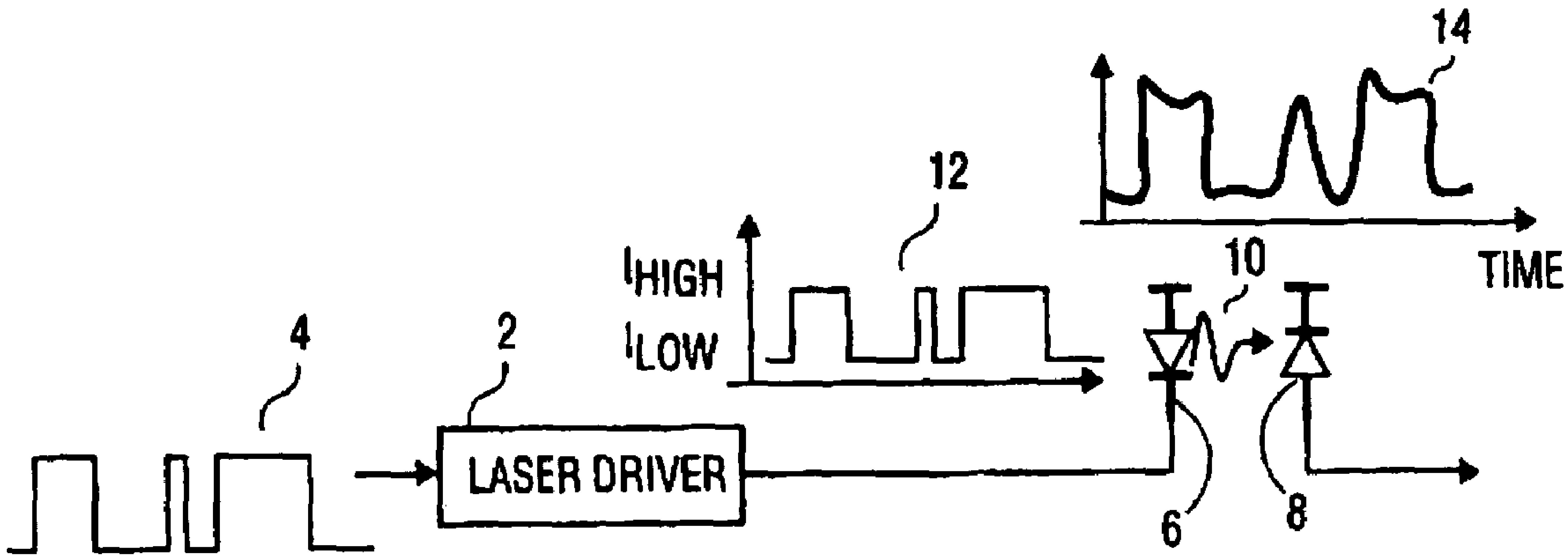


FIG. 1
(PRIOR ART)

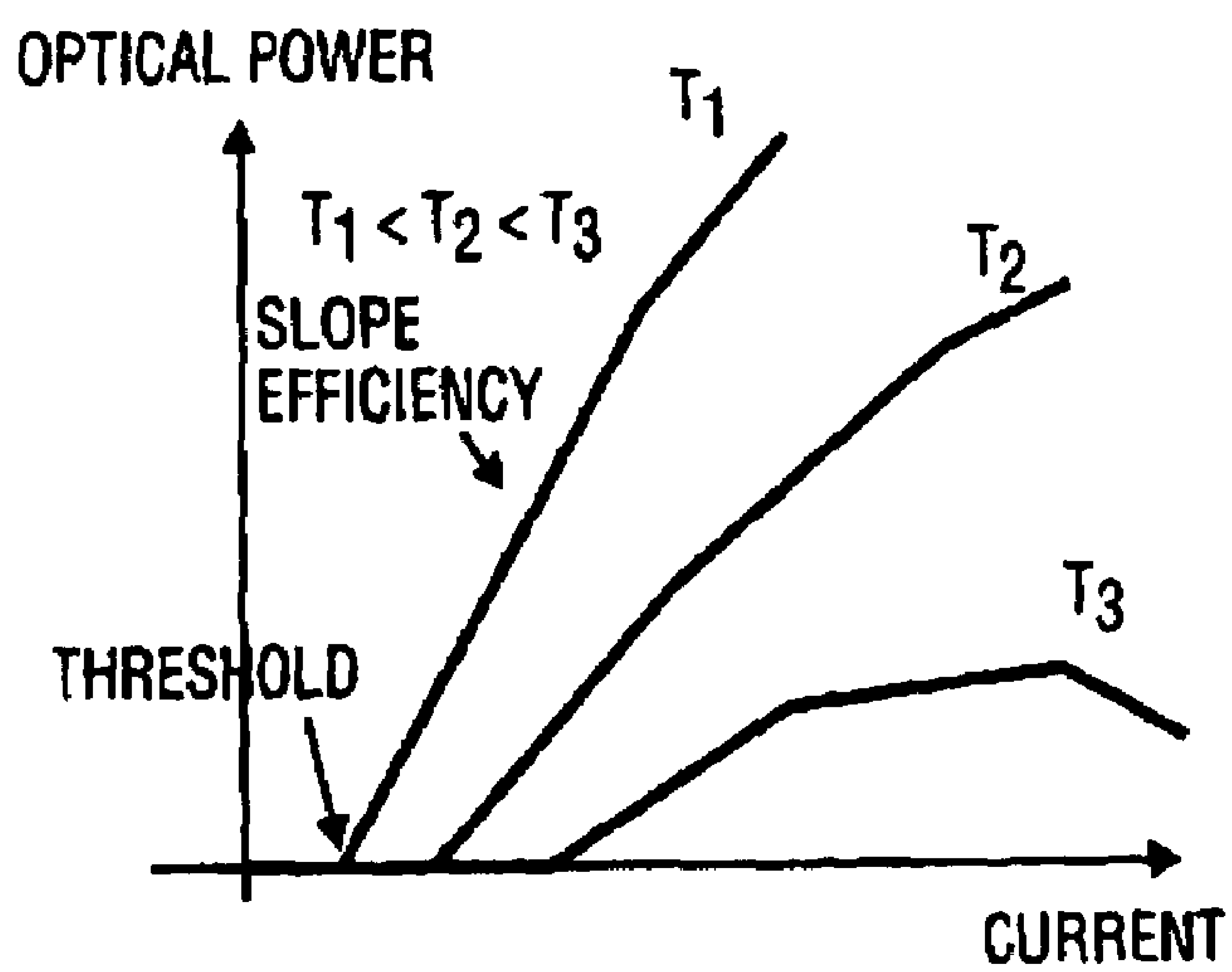


FIG. 2
(PRIOR ART)

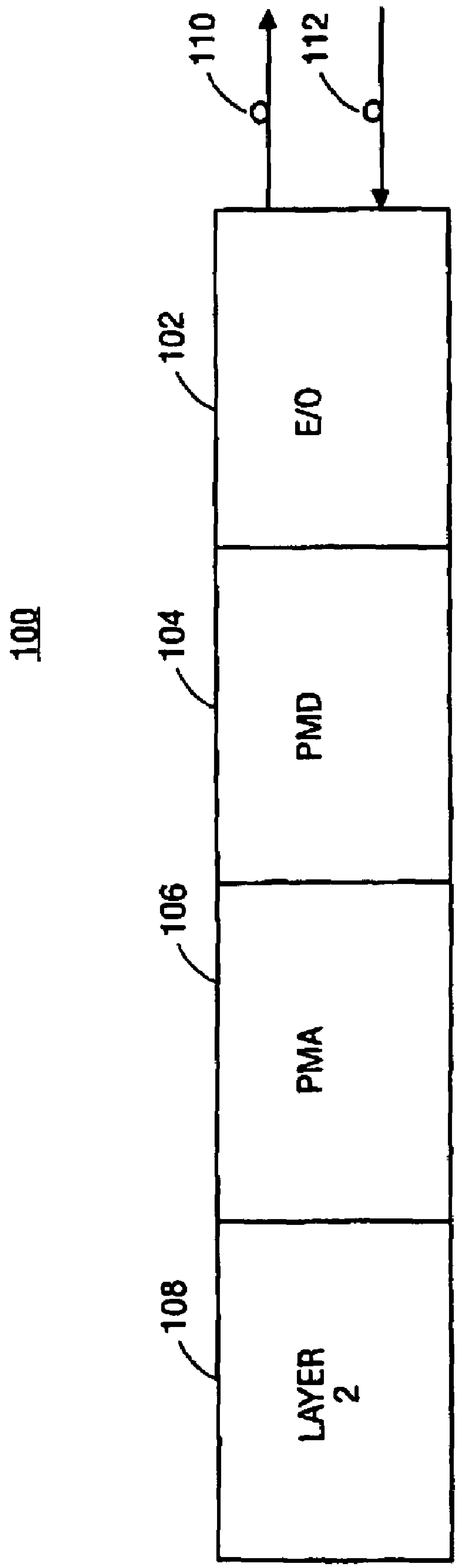


FIG. 3

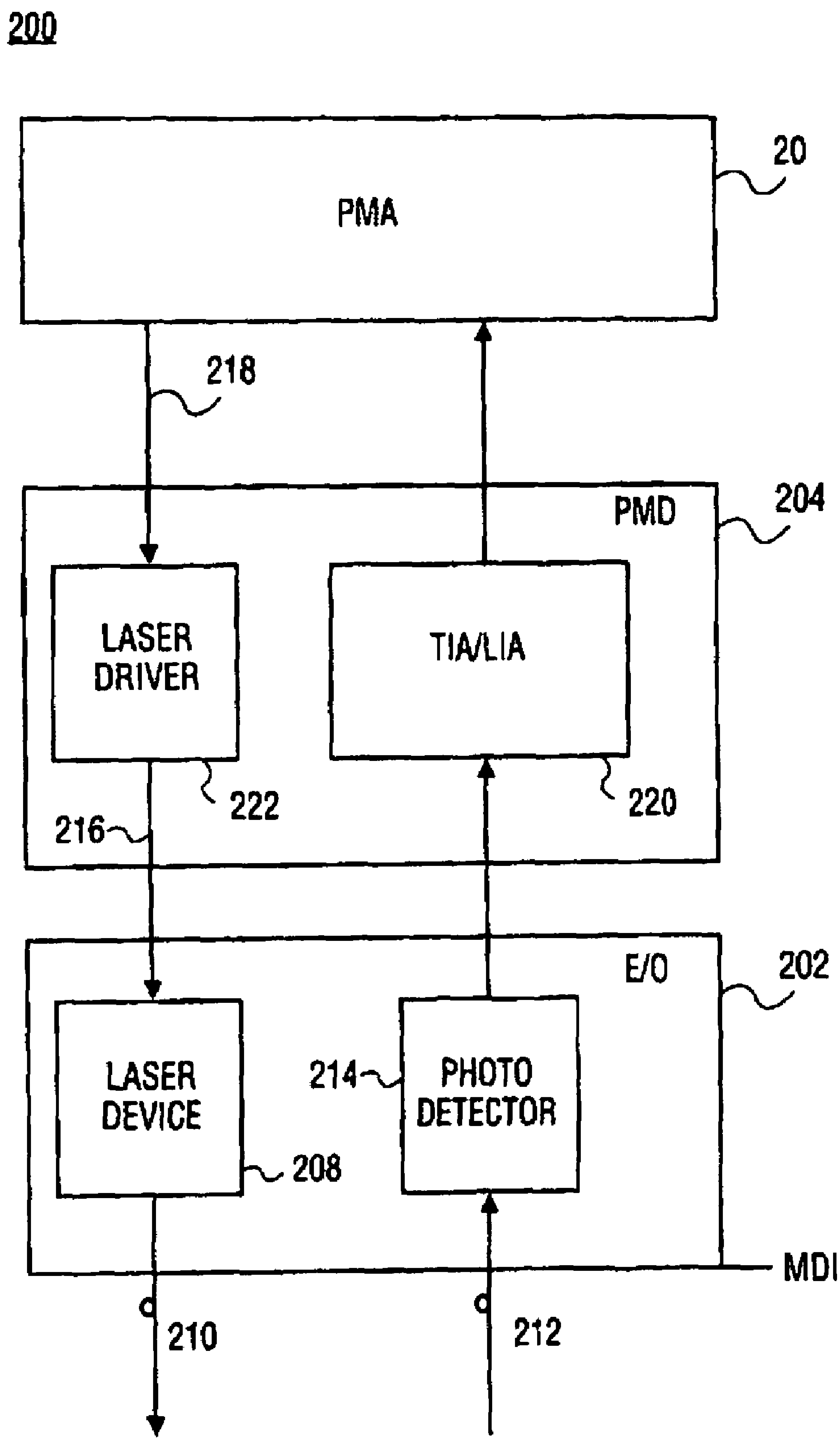
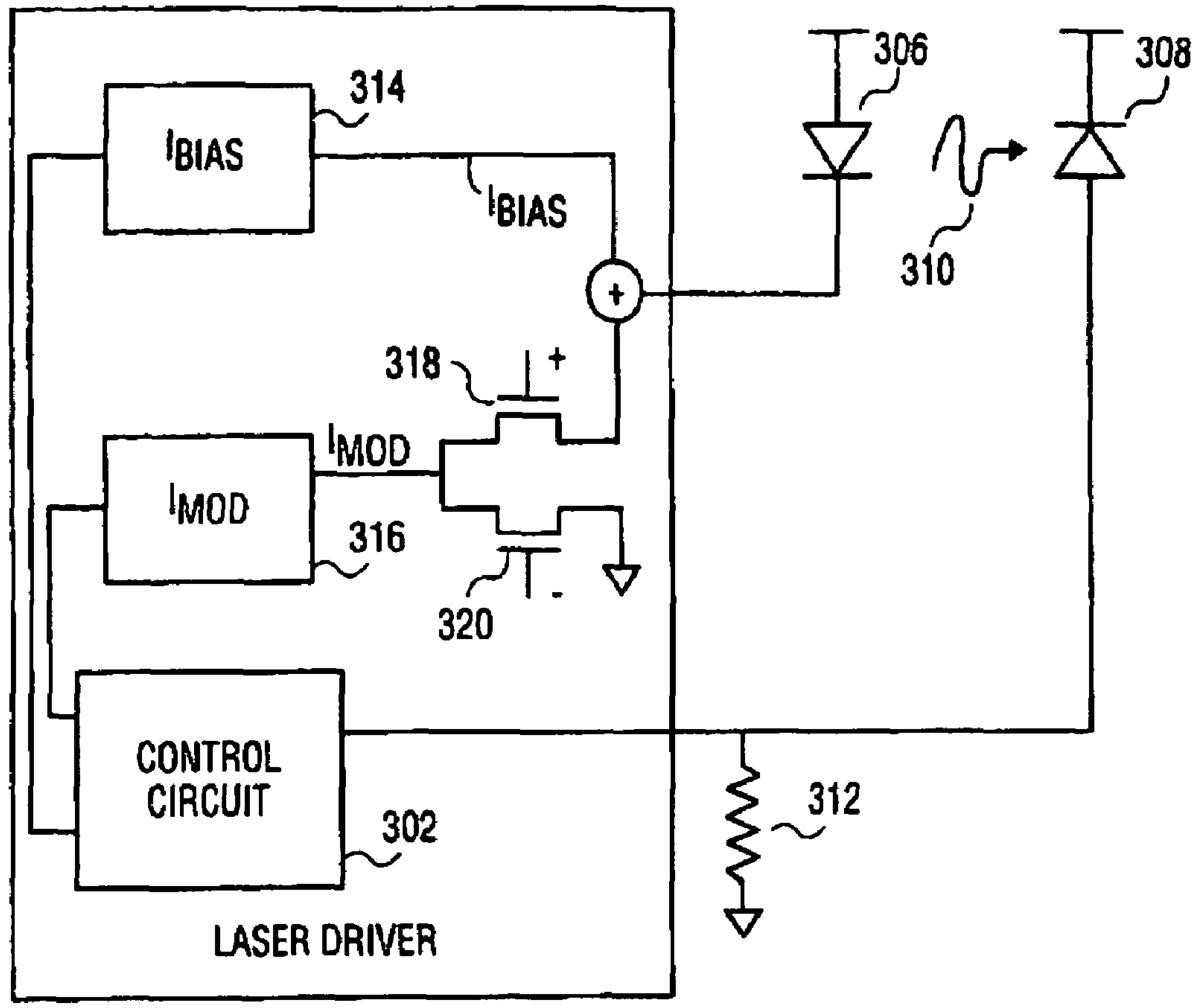
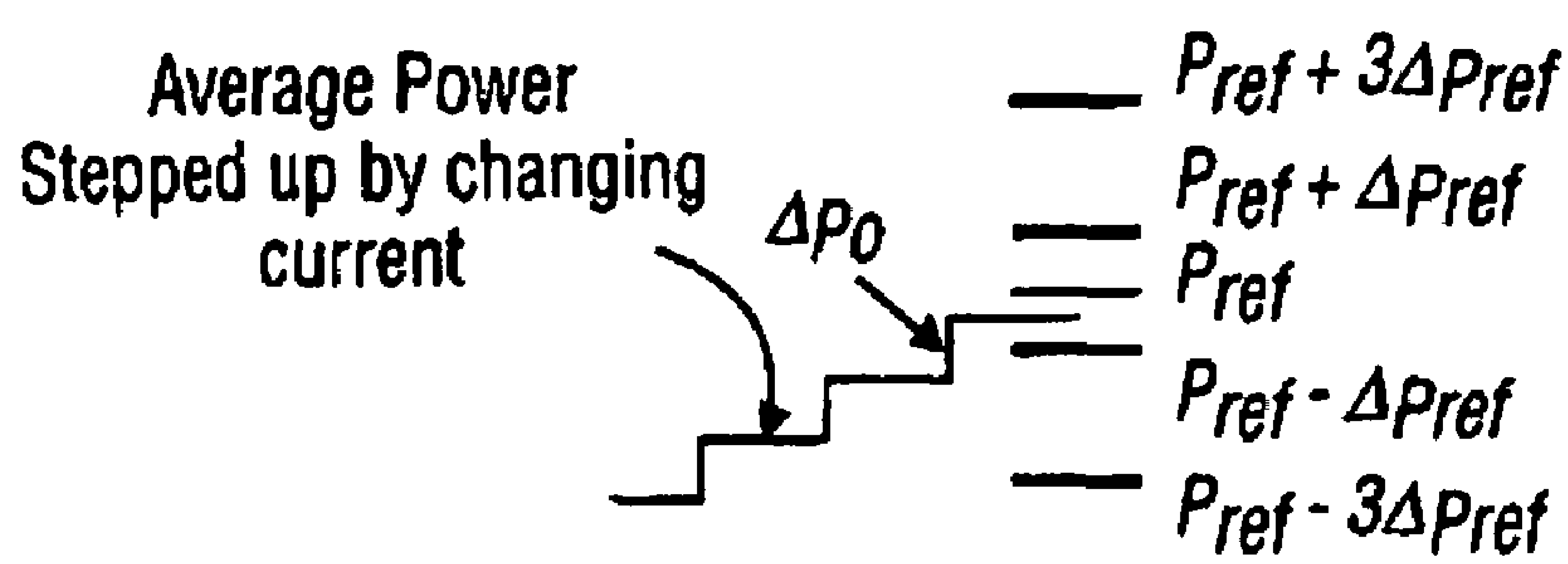

200
PMA
20
218
PMD
204
LASER DRIVER
TIA/LIA
222
220
216
E/O
202
LASER DEVICE
214
PHOTO DETECTOR
208
MDI
210
212

FIG. 4



IBIAS
314
IBIAS
306
308
310
318
+
IMOD
IMOD
316
320
-
CONTROL CIRCUIT
302
312
LASER DRIVER

FIG. 5



Average Power Stepped up by changing current
ΔPo
Pref + 3ΔPref
Pref + ΔPref
Pref
Pref - ΔPref
Pref - 3ΔPref

FIG. 7

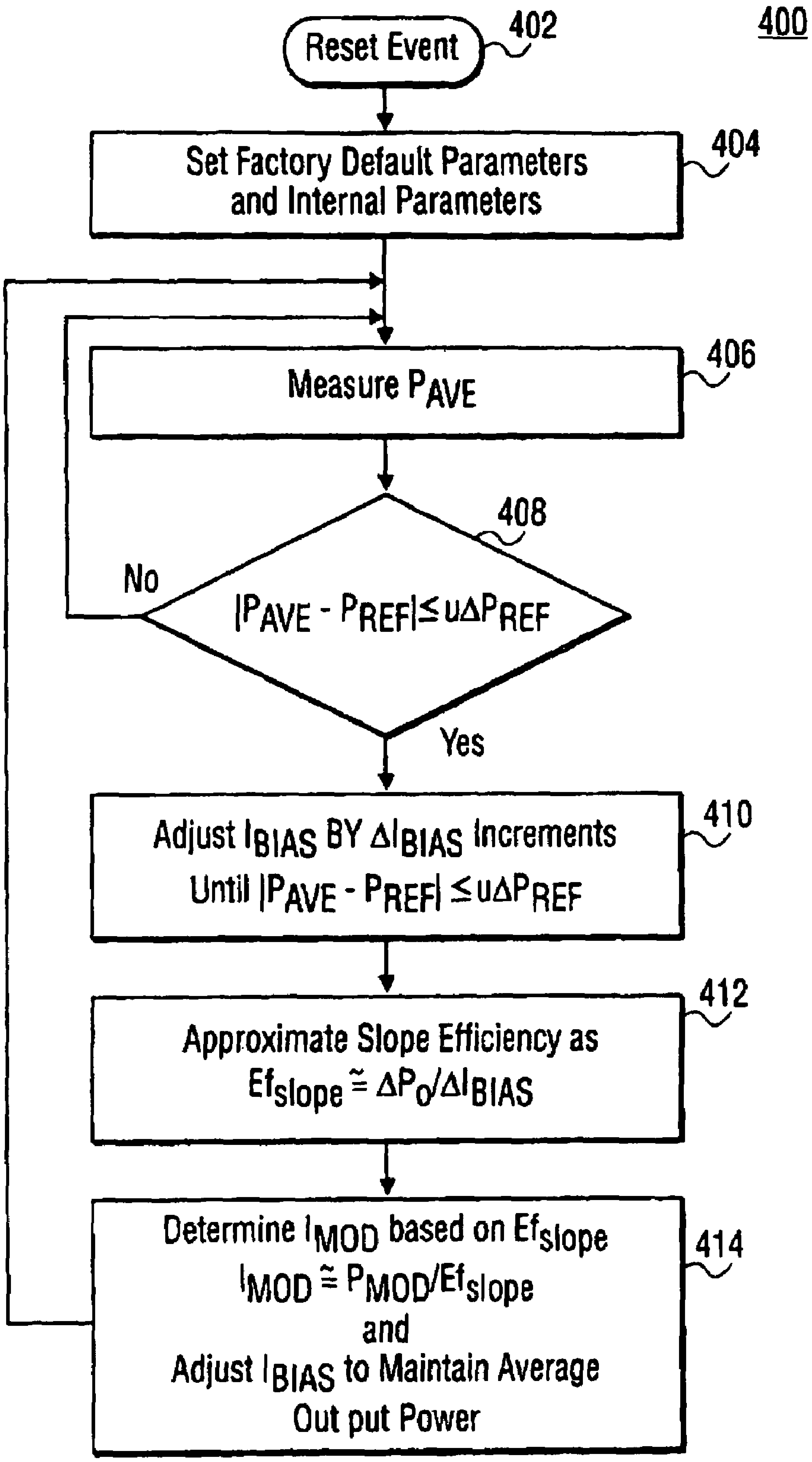

400
Reset Event
402
Set Factory Default Parameters and Internal Parameters
404
Measure P_{AVE}
406
408
No
$|P_{AVE} - P_{REF}| \leq u\Delta P_{REF}$
Yes
Adjust I_{BIAS} BY ΔI_{BIAS} Increments Until $|P_{AVE} - P_{REF}| \leq u\Delta P_{REF}$
410
Approximate Slope Efficiency as $Ef_{slope} \cong \Delta P_0/\Delta I_{BIAS}$
412
Determine I_{MOD} based on Ef_{slope}
$I_{MOD} \cong P_{MOD}/Ef_{slope}$
and
Adjust I_{BIAS} to Maintain Average Out put Power
414

FIG. 6

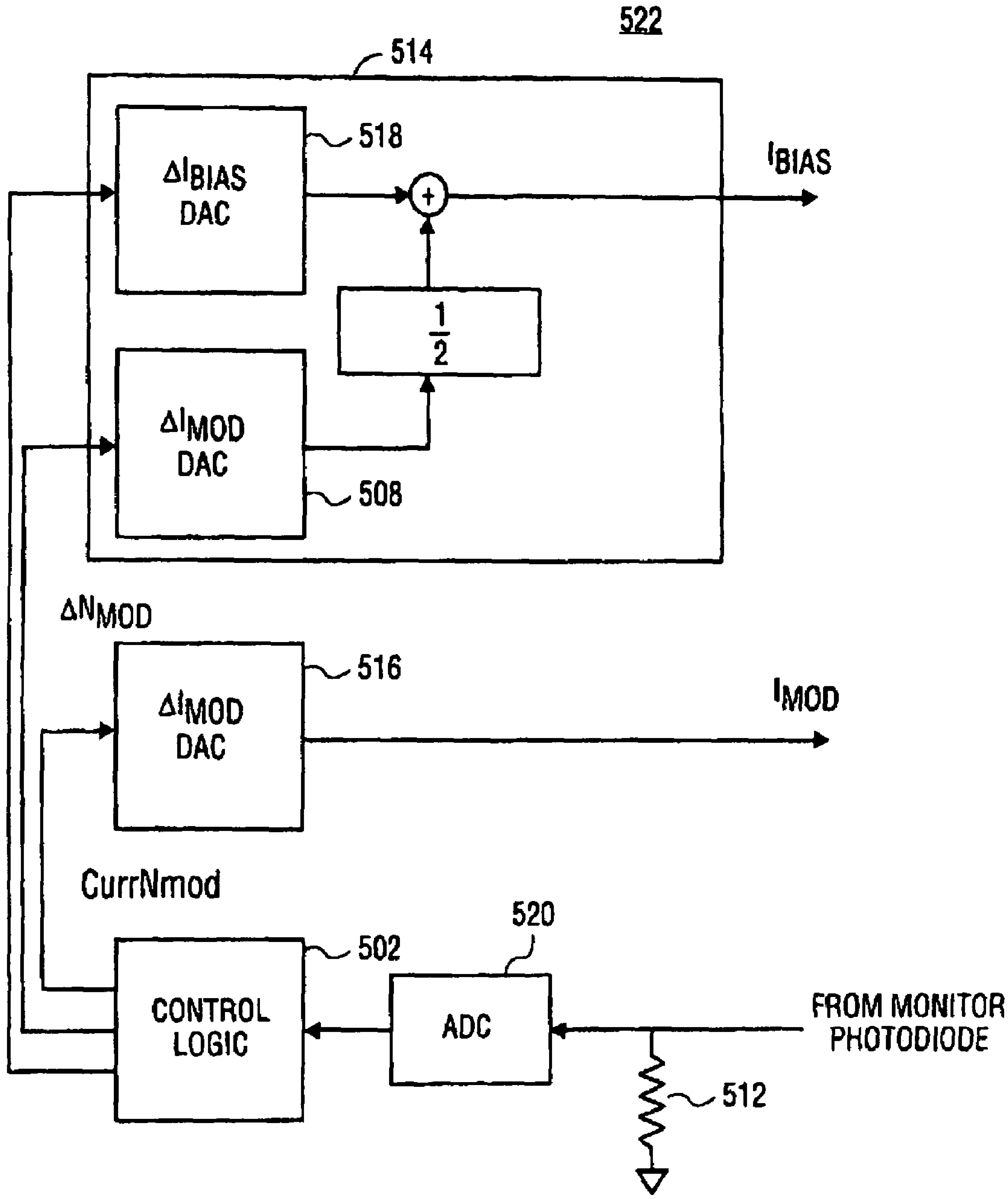

522
514
518
ΔIBIAS DAC
IBIAS
+
1/2
ΔIMOD DAC
508
ΔNMOD
516
ΔIMOD DAC
IMOD
CurrNmod
520
502
CONTROL LOGIC
ADC
FROM MONITOR PHOTODIODE
512

FIG. 8

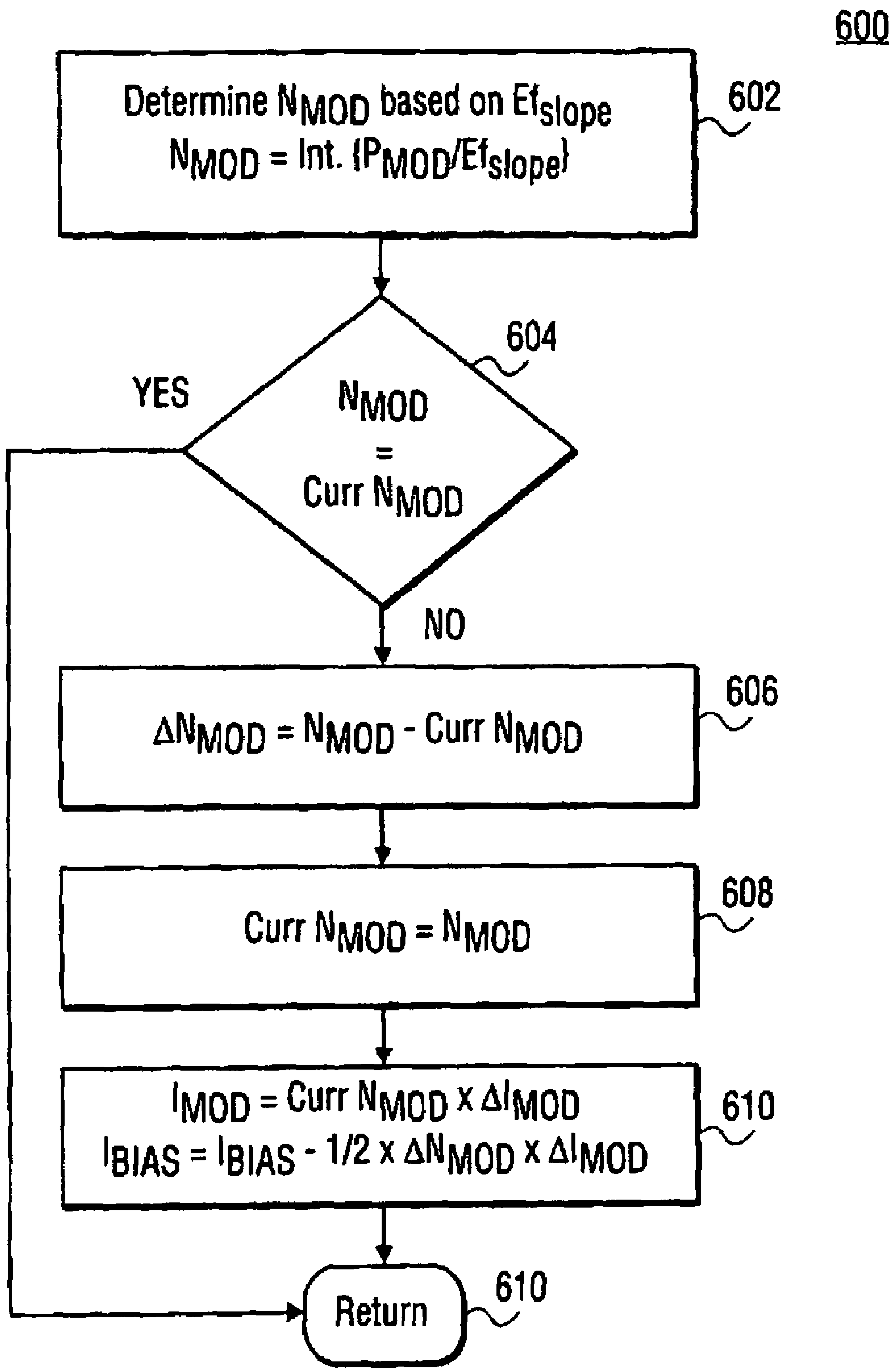

600
Determine N_{MOD} based on Ef_{slope}
N_{MOD} = Int. {P_{MOD}/Ef_{slope}}
602
604
YES
N_{MOD} = Curr N_{MOD}
NO
$\Delta N_{MOD} = N_{MOD}$ - Curr N_{MOD}
606
Curr $N_{MOD} = N_{MOD}$
608
I_{MOD} = Curr $N_{MOD} \times \Delta I_{MOD}$
$I_{BIAS} = I_{BIAS} - 1/2 \times \Delta N_{MOD} \times \Delta I_{MOD}$
610
Return
610

FIG. 9

LASER DRIVER CIRCUIT AND SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 10/321,177 filed on Dec. 16, 2002, now U.S. Pat. No. 6,928,094, the teachings of which are herein incorporated by reference.

BACKGROUND

1. Field

The subject matter disclosed herein relates to data communication systems. In particular, the subject matter disclosed herein relates to transmitting data in an optical transmission medium.

2. Information

Data transmission in an optical transmission medium such as fiber optic cabling has enabled communication at data rates of 10 gigabits per second and beyond according to data transmission standards set forth in IEEE Std. 802.3ae-2002, Synchronous Optical Network/Synchronous Digital Hierarchy (SONET) protocol as indicated in a set of standards provided by the American National Standards Institute (ANSI T1.105.xx) or Synchronous Digital Hierarchy (SDH) as indicated in a set of recommendations provided by the International Telecommunications Union (e.g., ITU-T G.707, G.708, G.709, G.783 and G.784). To transmit data in the optical transmission medium, a laser device typically modulates an optical signal in response to a data signal.

FIG. **1** shows a schematic diagram of a prior art laser driver circuit **2** to provide power to a laser diode **6**. In response to a pulse data signal **4**, the laser driver circuit **2** provides a pulse current signal **12** and a nominally fixed bias current (not shown) to the laser diode **6**. In response to the pulse current signal **12**, the laser diode **6** transmits a light signal **10** having an output power **14**. A photodiode **8** measures the output power **14** to be used in evaluating the performance of the laser driver circuit **2** or the laser diode **6**.

A "slope efficiency" typically expresses an efficiency of a laser device in generating an output power in response to an input current signal. For example, a slope efficiency is typically expressed as a measurement of a change in output power of a light signal from a laser device divided by a magnitude of a change in input current signal provided to the laser device to transmit the light signal when the laser device is properly biased. The slope efficiency associated with a particular laser device typically changes as a function of age or operating temperature. For example, FIG. **2** shows a graph illustrating effects of temperature (i.e., different temperatures T_1, T_2 and T_3 on a slope efficiency of a laser device. In the illustrated example, the laser device has a higher slope efficiency at lower operating temperatures.

BRIEF DESCRIPTION OF THE FIGURES

Non-limiting and non-exhaustive embodiments of the present invention will be described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various figures unless otherwise specified.

FIG. **1** shows a schematic diagram of a prior art laser driver circuit to provide power to a laser device;

FIG. **2** shows a graph illustrating typical effects of temperature on a slope efficiency associated with a laser device;

FIG. **3** shows schematic diagram of a system to transmit in and receive data from an optical transmission medium according to an embodiment of the present invention;

FIG. **4** shows a schematic diagram of physical medium attachment and physical medium dependent sections of a data transmission system according to an embodiment of the system shown in FIG. **2**;

FIG. **5** shows a schematic diagram of a laser driver circuit according to an embodiment of the physical medium dependent section shown in FIG. **4**;

FIG. **6** shows a flow diagram illustrating a process of adjusting an output current of a laser driver circuit according to an embodiment of the laser driver circuit shown in FIG. **5**;

FIG. **7** shows a graph illustrating changes of an output power of a light signal from a laser device in response to changes in an output current from a laser device according to an embodiment of the process shown in FIG. **6**;

FIG. **8** shows a laser driver circuit according to an embodiment of the laser driver circuit shown in FIG. **5**; and

FIG. **9** shows a flow diagram illustrating a process according to an embodiment of the process shown in FIG. **6** and the laser driver circuit shown in FIG. **8**.

DETAILED DESCRIPTION

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearances of the phrase "in one embodiment" or "an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in one or more embodiments.

"Machine-readable" instructions as referred to herein relates to expressions which may be understood by one or more machines for performing one or more logical operations. For example, machine-readable instructions may comprise instructions which are interpretable by a processor compiler for executing one or more operations on one or more data objects. However, this is merely an example of machine-readable instructions and embodiments of the present invention are not limited in this respect.

"Storage medium" as referred to herein relates to media capable of maintaining expressions which are perceivable by one or more machines. For example, a storage medium may comprise one or more storage devices for storing machine-readable instructions or data. Such storage devices may comprise storage media such as, for example, optical, magnetic or semiconductor storage media. However, this is merely an example of a storage medium and embodiments of the present invention are not limited in this respect.

"Logic" as referred to herein relates to structure for performing one or more logical operations. For example, logic may comprise circuitry which provides one or more output signals based upon one or more input signals. Such circuitry may comprise a finite state machine which receives a digital input and provides a digital output, or circuitry which provides one or more analog output signals in response to one or more analog input signals. Such circuitry may be provided in an application specific integrated circuit (ASIC) or field programmable gate array (FPGA). Also, logic may comprise machine-readable instructions stored in a storage medium in combination with processing circuitry to execute such machine-readable instructions. However, these are merely examples of structures which may provide logic and embodiments of the present invention are not limited in this respect.

A "data bus" as referred to herein relates to circuitry for transmitting data between devices. A "multiplexed data bus" as referred to herein relates to a data bus that is capable of transmitting data among two or more devices coupled to the multiplexed data bus. A multiplexed data bus may transmit data messages to a device coupled to the multiplexed data bus according to an address associated with the device or a position on the multiplexed data bus where the device is coupled. However, this is merely an example of a multiplexed data bus and embodiments of the present invention are not limited in this respect.

An "optical transmission medium" as referred to herein relates to a transmission medium capable of transmitting light energy in an optical signal which is modulated by a data signal such that the data signal is recoverable by demodulating the optical signal. For example, an optical transmission medium may comprise fiber optic cabling coupled between a transmitting point and a receiving point However, this is merely an example of an optical transmission medium and embodiments of the present invention are not limited in this respect.

A "laser device" as referred to herein relates to a device to transmit a light signal in response to a power source. For example, a laser device may transmit a light signal in an optical transmission medium which is modulated by a data signal. However, this is merely an example of a laser device and embodiments of the present invention are not limited in these respects.

A "laser driver circuit" as referred to herein relates to a circuit to provide power to a laser device to be used for transmitting a light signal in an optical transmission medium. For example, a laser driver circuit may provide a controlled current signal to provide power for transmitting the light signal. However, this is merely an example of a laser driver circuit and embodiments of the present invention are not limited in these respects.

A laser driver circuit may provide a current signal to a laser device having a "bias current" component combined with a data current component which is modulated by a data signal. The data current signal may be generated by modulating a "modulation current" with the data signal. The modulation current may determine an extent to which the magnitude of the current signal may deviate from the bias current component. However, this is merely an example of a bias current and modulation current, and embodiments of the present invention are not limited in these respects.

The strength of a light signal from a laser device may be associated with a measurable "output power." For example, an output power from a laser device may be measured from a sensor such as a photodiode which is exposed to the light signal. However, this is merely an example of an output power associated with a laser device transmitting a light signal and embodiments of the present invention are not limited in this respect.

An "average output power" as referred to herein relates to an approximation of the mean output power of a laser device over a time period. For example, an average output power may be determined based upon an integration of an output from a sensor over a period of exposure to a light signal generated by the laser device and subsequent normalization. A "swing output power" as referred to herein relates to an amount by which an output power of a laser device may deviate from its lowest value to its highest value over a time period. However, these are merely examples of an average output power and swing output power, and embodiments of the present invention are not limited in these respects.

A "slope efficiency" as referred to herein relates to a relationship between a current signal provided to a laser device and a resulting output power of a light signal generated by the laser device in response to the current signal. For example, a slope efficiency may be expressed as a change in output power divided by a magnitude of a change in current signal. However, this is merely an example of a slope efficiency and embodiments of the present invention are not limited in these respects.

Briefly, an embodiment of the present invention relates to a laser driver circuit to provide a current signal to power a laser device. A bias current provided to the laser device may be changed while changes in the output power of a light signal from the laser device is monitored. A slope efficiency associated with the laser device may be determined based upon the changes in the bias current and changes in the output power. However, this is merely an example embodiment and other embodiments of the present invention are not limited in these respects.

FIG. **3** shows a schematic diagram of a system to transmit in and receive data from an optical transmission medium according to an embodiment of the present invention. AD optical transceiver **102** may transmit or receive optical signals **110** or **112** in an optical transmission medium such as fiber optic cabling. The optical transceiver **102** may modulate the transmitted signal **110** or demodulate the received signal **112** according to any optical data transmission format such as, for example, wave division multiplexing wavelength division multiplexing (WDM) or multi-amplitude signaling (MAS). For example, a transmitter portion (not shown) of the optical transceiver **102** may employ WDM for transmitting multiple "lanes" of data in the optical transmission medium.

A physical medium dependent (PMD) section **104** may provide circuitry, such as a transimpedance amplifier (TIA) (not shown) and/or limiting amplifier (LIA) (not shown), to receive and condition an electrical signal from the optical transceiver **102** in response to the received optical signal **112**. The PMD section **104** may also provide to a laser device (not shown) in the optical transceiver **102** power from a laser driver circuit (not shown) for transmitting an optical signal. A physical medium attachment (PMA) section **106** may include clock and data recovery circuitry (not shown) and de-multiplexing circuitry (not shown) to recover data from a conditioned signal received from the PMD section **104**. The PMA section **106** may also comprise multiplexing circuitry (not shown) for transmitting data to the PMD section **104** in data lanes, and a serializer/deserializer (Serdes) for serializing a parallel data signal from a layer 2 section **108** and providing a parallel data signal to the layer 2 section **108** based upon a serial data signal provided by the clock and data recovery circuitry.

According to an embodiment, the layer 2 section **108** may comprise a media access control (MAC) device coupled to the PMA section **106** at a media independent interface (MII) as defined IEEE Std. 802.3ae-2002, clause 46. In other embodiments, the layer 2 section **108** may comprise forward error correction logic and a framer to transmit and receive data according to a version of the Synchronous Optical Network/Synchronous Digital Hierarchy (SONET) protocol as indicated in a set of standards provided by the American National Standards Institute or Synchronous Digital Hierarchy (SDH) as indicated in a set of recommendations provided by the International Telecommunications Union. However, these are merely examples of layer 2 devices that may provide a parallel data signal for transmission on an optical transmission medium, and embodiments of the present invention are not limited in these respects.

The layer 2 section **108** may also be coupled to any of several input/output (I/O) systems (not shown) for communication with other devices in a processing platform. Such an I/O system may include, for example, a multiplexed data bus coupled to a processing system or a multi-port switch fabric. The layer 2 section **108** may also be coupled to a multi-port switch fabric through a packet classifier device. However, these are merely examples of an I/O system which may be coupled to a layer 2 device and embodiments of the present invention are not limited in these respects.

The layer 2 device **108** may also be coupled to the PMA section **106** by a backplane interface (not shown) over a printed circuit board. Such a backplane interface may comprise devices providing a 10 Gigabit Ethernet Attachment Unit Interface (XAUI) as provided in IEEE Std. 802.3ae-2002, clause 47. In other embodiments, such a backplane interface may comprise any one of several versions of the System Packet Interface (SPI) as defined by the Optical Internetworking Forum (OIF). However, these are merely examples of a backplane interface to couple a layer 2 device to a PMA section and embodiments of the present invention are not limited in these respects.

FIG. **4** shows a schematic diagram of a system **200** to transmit data in and receive data from an optical transmission medium according to an embodiment of the system shown in FIG. **3**. An optical transceiver **202** comprises a laser device **208** to transmit an optical signal **210** in an optical transmission medium and a photo detector section **214** to receive an optical signal **212** from the optical transmission medium. The photo detector section **214** may comprise one or more photodiodes (not shown) for converting the received optical signal **212** to one or more electrical signals to be provided to a TIA/LIA circuit **220**. A laser driver circuit **222** may provide a current signal **216** to the laser device **208** in response to a data signal from a PMA section **205**. The laser device **208** may then transmit optical signal **210** in response to the current signal **216**.

FIG. **5** shows a schematic diagram of a laser driver circuit **322** according to embodiment of the physical medium dependent section shown in FIG. **4**. A laser device comprising a laser diode **306** receives a current signal from the laser driver circuit **322** and generates a light signal **310** in response to the input current. A photodiode **308** may be used to monitor the output power of the light signal **310** by providing an output current to a control circuit **302** over a resistor **312**. A voltage at the resistor may be indicative of the output power of the laser diode **306**. Alternatively, instead of passing the output current over the resistor **312**, a TIA may be coupled to receive the output current and provide an output voltage to the control circuit **302**. However, these are merely examples of how an output power of a laser device may be measured and embodiments of the present invention are not limited in these respects.

The laser driver circuit **322** comprises a current source circuit **316** to generate a modulation current component (I_{MOD}) and a current source circuit **314** to generate a bias current component (I_{BIAS}). A switch transistor pair comprises switch transistors **318** and **320** to modulate a switched modulation current output in response to a data signal (e.g., from a PMA section) applied to gates of the switch transistors **318** and **320**. The switched modulation current and bias current components may be additively combined using techniques known to those of ordinary skill in the art of analog circuit design to provide a current signal for powering the laser diode **306**.

In the illustrated embodiment, the current source circuits **314** and **316** may adjust the magnitudes of I_{MOD} or I_{BIAS} in response to control signals from the control circuit **302** to adjust the output power of the laser diode **306**. In one embodiment, the current source circuits **314** and **316** may increase or decrease the magnitudes of I_{MOD} or I_{BIAS} continuously over a time period to enable data recovery circuitry at a receiving end (not shown) to respond to changes in the output power. Alternatively, the current source circuits **314** and **316** may change the magnitudes of I_{MOD} or I_{BIAS} as a step function for a faster response. However, these are merely examples of how a modulation current or bias current may be adjusted in response to a control signal and embodiments of the present invention are not limited in these respects.

According to an embodiment, the laser driver circuit **322** may be associated with preset system parameters (e.g., preset by a manufacturer) such as a target reference average output power (P_{REF}) and a target modulation power or swing output power (P_{MOD}). FIG. **6** shows a flow diagram illustrating a process **400** to adjust I_{BIAS} and/or I_{MOD} according to an embodiment of the laser driver circuit **322**. At bubble **402**, a reset event may be detected such as a power up event. Block **404** may set internal parameters and factory default parameters including, for example, P_{MOD} and P_{REF} . Blocks **406** through **414** comprise a processing loop that may then be executed until a subsequent reset event.

Block **406** and diamond **408** may detect an event or condition to initiate a change in I_{BIAS} or I_{MOD} to maintain the average output power of the laser diode **306** at about P_{REF}. Such an event or condition may include, for example, a change in the temperature of the laser diode **306** (e.g., as measured by a thermistor (not shown)) or a change in the average output power (P_{AVE}) from the laser device **306** (e.g., as measured from the output of the photodiode **308**). However, these are merely examples of a condition or event that may initiate a change in I_{BIAS} or I_{MOD}, and embodiments of the present invention are not limited in these respects. Block **406** measures P_{AVE} and diamond **408** determines whether P_{AVE} is within a suitable range (e.g., as defined in parameters set at block **404**) about P_{REF}. If P_{AVE} is not within the suitable range about P_{REF}, block **408** may adjust I_{BIAS} until P_{AVE} is within the suitable range.

According to an embodiment the current source circuit **314** may adjust I_{BIAS} in discrete current increments (ΔI_{BIAS}) in response to a digital control signal from the control circuit **302**. At block **410**, I_{BIAS} may be adjusted by one or more increments ΔI_{BIAS} (e.g., added to or subtracted from I_{BIAS}) until P_{AVE} is within a suitable range. As illustrated in FIG. **7**, for example, I_{BIAS} may be adjusted until P_{AVE} is within the range P_{REF} +/−nΔP_{REF} where ΔP_{REF} and n define a predetermined tolerance for P_{AVE}.

Following the adjustment of $I._{BIAS}$ at block **410**, the control circuit **302** may approximate a slope efficiency (Ef_{slope}) associated with the laser diode **306** at block **412**. According to the embodiment of FIG. **7**, Ef_{slope} may be approximated based upon a discrete current increment ΔI_{BIAS} and the change in average output power (ΔP_o) resulting from the last current increment ΔI_{BIAS} added to or subtracted from I_{BIAS} at block **410** (to place P_{AVE} within the range P_{REF} +/−nΔP_{REF} as follows:

$$Ef_{slope} \approx \Delta P_o / \Delta I_{BIAS}$$

According to an embodiment, the control circuit **302** may provide a control signal to the current source circuit **316** to maintain a modulation current I_{MOD}. At block **414**, the control circuit **302** may determine I_{MOD} based upon P_{MOD} and the slope efficiency approximation $\Delta P_o/\Delta I_{BIAS}$ as follows:

$$I_{MOD}=P_{MOD}/(\Delta P_O/\Delta I_{BIAS})$$

To maintain P_{AVE} within a suitable operating range, I_{BIAS} may be reduced by an amount of current based upon the adjusted modulation current I_{MOD}. In the presently illustrated embodiment, it may be assumed that the output power of the laser diode **306** is approximately symmetric about P_{AVE} in response to the modulation current I_{MOD}. Accordingly, the bias current I_{BIAS} determined at block **410** may be reduced by about half of any increase to I_{MOD} to maintain P_{AVE} within a suitable operating range. However, this is merely an example of how a bias current may be reduced to maintain the average output power of a laser diode within a suitable range and embodiments of the present invention are not limited in these respects.

FIG. **8** shows a diagram illustrating a laser driver circuit **522** according to an embodiment of the laser driver circuit **322** illustrated with reference to FIGS. **5** and **6**. An analog to digital convener (ADC) **520** may provide digital samples of a voltage signal from a monitor photodiode to control logic **502** used for measuring P_{AVE} and ΔP_o, according to an embodiment of the control circuit **302** described with reference to FIG. **6**. Current source circuits **514** and **516** each comprise one or more digital-to-analog converters (DACs) to provide a current at a magnitude controlled by a digital signal from the control logic **502**. Circuitry to form such DACs to generate a digitally controlled current may be implemented using techniques known to those of ordinary skill in the art of analog circuit design.

FIG. **9** shows a flow diagram illustrating a process **600** according to an embodiment of the processing in the block **414** portion of process **400** shown in FIG. **6**. and the laser driver circuit **522** shown in FIG. **8**. A DAC **516** may generate I_{MOD} as an integer multiple of ΔI_{MOD} generated as follows:

$$I_{MOD}=N_{MOD}\times\Delta I_{MOD}$$

In the illustrated embodiment, N_{MOD} may be calculated as an integer from the approximated slope efficiency Ef_{slope} (calculated at block **412**) and diamond **604** may determine whether there has been a change to N_{MOD} resulting from any change to Ef_{slope}. Diamond **604** may compare N_{MOD} as calculated at block **602** to $CurrN_{MOD}$ which is a previously stored value of N_{MOD} (e.g., initialized at block **404** following reset). If N_{MOD} has changed, block **606** may provide an updated N_{MOD} signal as $CurrN_{Mod}$ to DAC **516** to generate I_{MOD} as an integer multiple $CurrN_{Mod}$ of discrete current increments ΔI_{MOD}.

Since any changes to I_{MOD} (resulting from changes in N_{MOD}) may cause a change in P_{AVE}, I_{BIAS} may be adjusted to maintain P_{AVE} within a suitable range. At block **410**, the control logic **502** may provide a digital control signal to a DAC **518** to increase or decrease the output current from DAC **518** by the discrete current increments ΔI_{BIAS} to place P_{AVE} within a suitable operating range as illustrated with reference to FIG. **7**. At block **606**, the control logic **502** may provide signal $CurrN_{MOD}$ as a digital control signal to a DAC **516** to generate I_{MOD} based upon the approximated slope efficiency Ef_{slope}.

According to an embodiment, the DAC **516** may provide I_{MOD} as an integer multiple (N_{MOD}) of discrete current increments ΔI_{MOD} based upon Ef_{slope}.

Accordingly, the DAC **516** may generate a modulation current $I_{MOD}=CurrN_{MOD}\times\Delta I_{MOD}$ in response to a digital control signal from the control logic **502** to maintain a swing output power at about the target modulation power P_{MOD}. To maintain the average power P_{AVE} within a suitable operating range, the current source circuit **514** may offset the output current from the DAC **518**. A DAC **508** may generate a current in response to a digital signal ΔN_{MOD} which represents a change in $CurrN_{MOD}$ (updated at block **608**). Here, the DAC **508** may generate a current $\Delta N_{MOD}\times\Delta I_{MOD}$. Half of this output current from the DAC **508** may be subtracted from the output of DAC **518** to provide I_{BIAS} using techniques known to those of ordinary skill in the art of analog circuit design.

While there has been illustrated and described what are presently considered to be example embodiments of the present invention, it will be understood by those skilled in the art that various other modifications may be made, and equivalents may be substituted, without departing from the true scope of the invention. Additionally, many modifications may be made to adapt a particular situation to the teachings of the present invention without departing from the central inventive concept described herein. Therefore, it is intended that the present invention not be limited to the particular embodiments disclosed, but that the invention include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A method comprising:

determining a magnitude of a modulation current provided to a laser device based upon an approximated slope efficiency and a target output power swing, wherein the approximated slope efficiency is based upon at least one discrete incremental change in a bias current to the laser device and at least one change in output power from the laser device, and wherein the target output power swing is a predetermined range of output power values of the laser device; and

determining a magnitude of the bias current provided to the laser device based upon the approximated slope efficiency.

2. The method of claim **1** further comprising:

selectively adjusting the bias current based upon the approximated slope efficiency in response to a change in the modulation current.

3. The method of claim **2** wherein adjusting the bias current includes:

maintaining the output power of the laser device within a predetermined power range.

4. A system comprising:

a laser device, adapted to be coupled to an optical transmission medium, for transmitting an optical signal in the optical transmission medium in response to a data signal; and

a laser driver circuit for providing a power signal to the laser device, the laser driver circuit comprising:

logic to determine a magnitude of a modulation current provided to the laser device based upon an approximated slope efficiency and a target output power swing, wherein the approximated slope efficiency is based upon at least one discrete incremental change in a bias current to the laser device and at least one change in output power from the laser device, and wherein the target output power swing is a predetermined range of output power values of the laser device; and

logic to selectively determine a magnitude of the bias current provided to the laser device based upon the approximated slope efficiency.

5. The system of claim **4** further comprising:

logic to selectively adjust the bias current in response to a change in the modulation current.

6. The system of claim **5**, wherein the logic to selectively adjust the bias current includes:

logic to maintain the output power of the laser device within a predetermined power range.

7. The system of claim **4** further comprising:

a framer to provide the data signal to the laser device.

8. The system of claim **7** further comprising:

a switch fabric communicatively coupled to the framer.

9. The system of claim **4** further comprising:

an Ethernet MAC to provide the data signal at a media independent interface.

10. The system of claim **9** further comprising:

a bus coupled to the Ethernet MAC.

11. The system of claim **9** further comprising:

a switch fabric coupled to the Ethernet MAC.

12. The system of claim **4**, further comprising a layer **2** section logic configured to provide the data signal to the laser device.

13. The system of claim **4**, further comprising a physical medium attachment (PMA) section logic configured to provide the data signal to the laser device.

14. The system of claim **4**, further comprising a physical medium dependent (PMD) section logic configured to provide the data signal to the laser device.

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